

wind velocity and air coefficients has been worked out, which is already very promising. This takes account of the vertical convection upward in the Tropics, downward in the high pressure belt, together with the resulting trade winds; the horizontal overflow, somewhat greater in middle latitudes in the upper levels than in the lower levels, and its relation to the great eastward drift can be fully discussed; the variations of temperature in longitude and the effect in breaking up the general circulation by means of leakage currents can be deduced by the extension of the method. The application of such data to many localities is a work that will cost much labor, but the result will be to change climatology from a merely statistical subject of normals and departures into one of scientific procedure. If the laws of the modification of the local circulations can be worked out, there will follow the possibility of arriving at the laws of seasonal forecasts as regards the temperature and rainfall of special regions. It is entirely probable that the proper scientific approach to the problem of seasonal forecasts is to be along this line, however, it will require the labors of many students to do the necessary work of computation and discussion. It, also, seems quite likely that as soon as students more clearly perceive the nature of this great problem, the number of workers will increase.

RADIATION.

If the circulation of the earth's atmosphere is the cause of the local distributions of temperature and precipitation observed in climatology, we know that the solar radiation is the immediate source of the energy that drives the circulation. The subject here becomes complicated because the study of radiation in any easy way is hindered by the presence of aqueous vapor in the atmosphere considered as an absorbing layer of gases. The incoming radiation suffers three principal depletions: (1) by scattering and deflection upon the atoms, molecules, and dust or ice particles of the air, (2) by the absorption of short wave-length radiation chiefly in the outer or isothermal layer, (3) by the absorption of the somewhat longer wave lengths and other occasional long wave lengths in the lower aqueous vapors. In order to suitably observe solar radiation, it follows that regions of dry air, and air free from dust, are most advantageous. The atmosphere over the eastern districts of the United States is loaded with aqueous vapor and transported from the Gulf of Mexico, while the extreme southwestern districts, New Mexico, Arizona, and southern California are relatively free from vapor, being shielded by the mountain ranges of the Pacific coast. Some high-level stations and some desert stations in the Southwest are peculiarly adapted to study solar radiation. There are several lines of research which indicate that the solar radiation is variable, and it is of primary importance to establish a series of long-continued homogeneous radiation observations for this purpose. The irrigated district in the Imperial Valley, having very clear, cloudless skies, and comparatively low wind velocity, is a most promising place for a station. A suitable equipment for the climatological station at Brawley, Cal., should be considered in this connection.

SOLAR PHYSICS.

Numerous answers to questions in solar physics will probably follow the solution of similar problems for the earth's atmosphere. The relations between the temperature distribution and the velocity of the air in different levels follows similar laws, through the action of gravitation upon the resulting densities of the air masses. Apparently, by the observations on the surface, the solar disk is at the same temperature in all latitudes, and yet the large change in the velocity of rotation of the gaseous envelope in different latitudes, 26.70 days at the equator and 31.00 days at the poles for the photosphere, 26.00 days at the equator and 29.00 days at the poles for the upper chromosphere, must be the result of temperature distributions in order to conform to

the laws of general motion. The outer gaseous layers of the earth's atmosphere are nearly isothermal, but the lower ones have a well-known decrease of temperature from the equator to the poles. Similar deep-seated changes in temperature are to be expected on the sun, but the two systems are probably inverse to one another.

The incoming radiation is accompanied by magnetic and electrical effects. If corpuscles are expelled by the sun and transported to the earth in light waves, they should make a disturbance of the diurnal magnetic field centered about the solar meridian, by every analogy, if their energy is expended within the outer layers. The diurnal magnetic variations are evidently distributed about the diurnal temperature changes in two entirely parallel systems centered at about 2 o'clock in the afternoon. Since this temperature distribution is confined to the lower layers of the atmosphere it should follow that the incoming solar radiation has diurnal magnetic effects, controlled by the lower rather than by the outer layers. The corpuscles and absorbed radiation in the outer layers probably produce the irregular magnetic storms.

ECONOMIC STATISTICS.

There are numerous practical questions in climatology concerned with engineering, transportation, and agricultural interests. Careful statistics should be collected of the financial losses by floods to engineering structures, in order to study their efficiency in regard to the work called upon to be done by them. The sudden release of snows in the mountains by dynamic heated winds, and the best method of forecasting their recurrence should be studied for each locality. The effect of hurricanes upon sea walls, protecting breakwaters, and jetties is an important subject of research. The damage to buildings by high winds, and the architectural problems of their strength of resistance should be worked out. The railroads are interested in the washouts produced by rainfall, originally well distributed, but concentrated by run-off into dangerous destructive torrents of short duration. The railroads in the deserts and in the mountains of the West are expending large sums of money building dykes and protecting walls, and yet they possess only meager climatological data. The subject of the navigation of inland waterways depends upon the amount of snow and rainfall that is carried into the river channels. The effect of rainfall and evaporation upon soil fertility, the effect of winds and wind-breaks upon the vegetation in the fields call for careful examination.

In short the problems open to climatology and meteorology in their mutual relations cover a vast catalogue of work. It is proposed to publish in the MONTHLY WEATHER REVIEW the more practical aspects of these problems, and in the Mount Weather Bulletin the more theoretical studies, and papers are solicited for each publication.

AVERAGE ANNUAL RAINFALL OF PORTO RICO, W. I.

By O. L. FASSIG, Ph. D., Section Director, Porto Rico, W. I.

In the latter part of 1898 a station of the first order of the United States Weather Bureau was established in the city of San Juan, the capital of the newly acquired tropical island of Porto Rico. In the following year substations to the number of 30 or more were established over the island, at which the daily extremes of temperature, the amount of rainfall, the direction of the wind, and the general state of the weather were recorded daily. These substations were from time to time increased in number, and at the present time weather records are available for more than 50 localities for periods varying from 1 to 11 years. At 4 stations the observations antedate the American occupation: At San Juan extending back to 1870, at Canóvanas and at Mayagüez to 1889, and at Luquillo to 1896.

All of these records are now being reduced, under the direction of the Chief of the Weather Bureau, in the preparation of a

report upon the climate of Porto Rico. The present paper is confined to a brief preliminary survey of the average monthly and seasonal rainfall of the island, and to some of the more marked variations from what may, for the present, be regarded as normal values.

The island of Porto Rico is the smallest and easternmost of the Greater Antilles and lies between 18° and 18° 30' north latitude, and between 65° 40' and 67° 15' longitude west from Greenwich. The island is nearly rectangular in form, with an east-west length of about 100 miles and an average width of about 35 miles.

As local topography is one of the principal factors in the control of rainfall distribution, it is unfortunate that there is not available even a rough attempt at a topographic chart of the island. Such maps as there are show the location of a mountain range, the principal watershed, extending across the greater portion of the island from east to west, a little to the south of the central line; also a shorter east-west range, the Luquillo Mountains, in the extreme northeast portion of the island. From these two systems numerous spurs extend, mostly northward, cutting up the island into a complex system of hills and valleys, with the hundreds of small streams for which the island is noted. The mountain peaks of the Luquillo Range and the main divide rise to elevations of 3,000 to 3,500 feet. The main divide has an average elevation of, perhaps, 2,000 feet, while the main spurs will average from 1,000 to 1,500 feet. The lowlands are found only along the coast, forming a narrow strip along the north, east, and west coasts, with a broader belt along the south coast. The localities for which rainfall records are here given range in elevation from sea level to 2,600 feet, with an average altitude of 640 feet.

Fifteen of the 44 stations enumerated have elevations between 1,000 and 2,600 feet.

In the accompanying table the average rainfall is shown for months, seasons, and for the entire year, the length of the records varying from 5 to 20 years. The geographical distribution of rainfall over the island is shown more clearly by means of the seasonal and annual charts forming figs. 1 to 6.

Attention is directed only to the more important and striking characteristics of the rainfall distribution. The average annual rainfall for the island, as a whole, is 77 inches. The amounts vary from a minimum of 37 inches along the south coast—an area devoted largely to the cultivation of sugar cane—to a maximum of 136 inches on the eastern slope of the Luquillo Mountains in the northeast portion of the island, within the area of the proposed Luquillo National Forest Reserve. This range gives rise to a large number of little streams which water the extensive coffee and sugar plantations of the surrounding country. At stations along and near the south coast the average annual rainfall is about 45 inches; along the north coast, the region of the citrus fruits and pineapples, the average fall is about 65 inches. Along the east and west coasts the near-by mountains and hills cross the path of the prevailing winds and we find, in consequence, a heavier rainfall, with an average of 75 inches for the west coast and 85 inches for the east coast. Owing to similar favorable topographic conditions we find the rainfall considerably heavier in the interior of the island than along the north and south coasts, only a few miles distant.

There are three well-defined centers of heavy rainfall on the island: (1) The Luquillo Range, a heavily wooded and inaccessible region in the northeast; (2) the mountains about

Average monthly and seasonal precipitation (in inches) for the period 1899-1909 in Porto Rico, W. I.

Stations.	Number of years.	Elevation in feet.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Winter.	Spring.	Summer.	Autumn.	Year.
1. Adjuntas.....	9	1,700	3.85	1.21	4.03	5.53	8.79	7.48	7.94	12.16	11.03	12.78	8.73	4.91	9.97	18.35	27.58	32.54	88.44
2. Alto de la Bandera.....	5	2,600	3.26	3.86	4.54	5.54	9.14	7.16	8.56	12.64	13.58	14.46	9.49	4.96	12.08	19.22	26.26	37.53	95.19
3. Aguadilla.....	11	35	2.11	2.08	3.04	4.55	9.76	12.02	8.78	9.19	9.37	8.72	8.06	2.61	6.90	17.35	29.99	26.15	80.29
4. Aguirre.....	11	10	1.58	1.04	1.76	1.87	4.29	7.78	5.55	6.20	6.83	7.22	4.23	1.93	4.55	7.92	19.53	19.28	50.28
5. Alibonito.....	5	2,000	3.93	4.32	4.70	3.33	7.42	4.81	4.10	6.50	7.42	6.68	7.69	4.51	12.76	15.45	15.41	21.79	65.41
6. Arecibo.....	7	20	3.36	3.08	4.07	3.95	5.49	4.24	4.59	5.36	4.89	5.43	8.09	6.19	12.63	13.51	14.49	18.41	59.04
7. Arecupey (near Arecibo).....	5	1,000	3.24	4.65	4.44	5.76	6.17	5.35	3.91	9.11	9.58	6.76	10.29	8.17	16.06	16.37	18.37	26.62	77.42
8. Barros.....	8	2,000	5.72	3.32	5.48	4.39	10.02	4.74	5.61	4.61	7.91	8.67	8.89	7.36	16.40	19.89	14.96	25.47	76.72
9. Bayamon.....	11	75	4.41	2.53	4.14	4.64	6.52	8.22	6.50	9.21	7.83	6.92	8.53	6.43	13.36	15.30	23.93	23.28	75.87
10. Caguas.....	11	250	4.18	2.27	3.31	3.48	4.86	7.85	8.07	7.34	7.21	7.78	5.92	4.87	11.32	11.65	23.26	20.81	67.87
11. Canovanas.....	20	20	5.18	2.62	3.61	4.74	6.41	7.13	10.46	8.69	6.93	6.30	9.93	7.54	15.34	14.76	26.28	23.16	79.54
12. Carmelita (1).....	7	1,500	3.17	3.06	5.86	6.60	10.86	7.64	7.25	12.26	13.52	14.86	12.53	4.26	10.49	23.32	27.15	40.91	101.87
13. Carmelita (2).....	7	2,500	4.62	4.04	6.73	7.09	12.23	7.50	7.73	13.24	14.11	16.08	13.11	6.36	14.92	26.05	28.47	43.30	112.74
14. Cayey.....	11	1,300	3.44	2.61	3.26	4.04	5.32	8.35	6.87	8.03	7.17	7.44	7.33	4.52	10.57	12.62	23.25	21.94	68.38
15. Cidra.....	11	1,300	6.00	4.09	5.21	4.51	6.82	8.65	8.79	10.92	6.48	6.78	7.46	7.43	17.52	16.54	28.36	20.72	83.14
16. Coamo.....	8	800	3.43	1.48	1.77	3.30	4.26	5.60	3.58	5.97	5.26	6.81	6.43	4.04	8.95	9.83	15.15	18.50	52.43
17. Corozal.....	11	600	4.84	4.04	4.64	5.83	6.30	6.28	7.15	8.02	7.38	9.14	8.66	6.79	15.67	16.47	21.45	25.18	78.77
18. Fajardo.....	11	15	3.71	2.24	3.37	4.12	5.47	7.23	6.09	5.96	7.63	8.74	9.61	5.16	11.11	12.96	19.28	25.98	69.33
19. Guanica.....	8	15	1.28	0.70	1.74	2.56	4.00	4.37	1.94	4.08	4.26	6.01	4.94	1.29	3.27	8.30	10.39	15.20	37.16
20. Guayama.....	9	17	1.84	1.16	2.20	2.37	5.29	7.94	6.11	4.96	6.95	8.20	5.35	2.02	5.02	9.86	19.01	20.50	54.39
21. Humacao.....	11	60	4.16	2.32	3.95	5.09	9.40	10.17	7.99	9.55	10.66	9.56	8.37	5.17	11.65	18.44	27.71	28.59	86.39
22. Isabela.....	11	250	3.14	2.72	2.77	4.17	5.70	4.82	3.39	6.06	5.35	5.59	8.66	5.42	11.34	12.64	14.27	19.60	57.85
23. Isolina.....	11	1,400	4.78	4.21	6.34	6.46	12.28	7.24	5.89	8.79	11.25	8.75	10.35	8.52	17.51	25.08	21.92	30.35	94.86
24. Juana Diaz.....	11	200	0.94	0.64	1.63	2.64	4.66	5.66	4.23	5.87	6.75	8.68	5.86	1.79	3.37	8.93	15.76	21.29	49.35
25. Lares.....	7	1,400	2.94	3.72	5.24	7.53	10.50	8.68	8.12	10.16	9.09	10.43	10.21	5.71	12.37	23.27	26.96	29.73	92.33
26. Las Marias.....	9	1,000	3.14	2.65	6.19	6.94	14.08	10.56	10.18	13.14	13.55	12.17	10.71	4.46	10.25	27.21	33.88	36.43	107.77
27. Luquilla (1).....	9	500	7.22	3.04	6.29	10.60	14.98	13.57	15.15	11.56	11.83	15.39	16.22	9.47	19.73	31.87	40.88	43.44	135.72
28. Luquilla (2).....	9	1,200	8.21	3.39	6.54	11.27	14.94	13.76	14.56	11.14	12.24	13.94	16.23	9.36	20.96	32.76	39.45	42.41	136.57
29. Manati.....	11	85	3.76	3.46	4.95	4.92	4.85	5.05	6.09	5.65	6.84	6.59	9.86	7.43	14.65	14.72	16.79	23.29	69.45
30. Maunabo.....	11	40	4.33	3.11	3.97	3.30	7.20	10.71	7.66	7.99	9.16	11.13	8.10	5.30	12.74	14.47	26.36	28.39	81.96
31. Mayaguez.....	15	20	2.05	1.66	2.90	4.51	7.60	7.66	9.62	8.87	8.87	7.99	6.25	2.81	6.54	15.01	27.15	23.11	71.81
32. Morovis.....	9	375	5.25	3.38	6.38	5.74	8.35	5.63	6.39	11.06	8.61	10.01	8.62	7.70	16.33	20.47	23.08	27.24	87.12
33. Ponce.....	11	50	1.00	0.69	1.38	1.99	3.17	5.48	3.47	5.25	5.75	7.46	3.81	1.12	2.81	6.64	14.20	17.03	40.57
34. Rio Blanco.....	6	150	5.04	5.82	6.36	5.85	10.56	12.58	10.96	12.17	13.36	12.18	10.99	7.30	18.16	22.77	35.71	36.63	113.17
35. Rio Piedras.....	8	75	3.90	3.07	4.16	4.31	6.23	6.68	6.25	8.47	7.69	5.94	7.04	7.07	14.04	14.70	21.40	20.67	70.81
36. San German.....	11	200	2.24	2.29	3.69	5.74	5.81	6.17	5.49	7.41	6.38	9.06	8.09	3.94	8.47	15.24	19.07	24.43	67.21
37. San Lorenzo.....	10	200	3.19	2.40	4.25	4.54	6.98	12.64	9.58	8.00	10.04	9.43	7.04	5.08	10.67	15.77	30.22	26.51	83.17
38. San Juan.....	11	82	4.52	2.10	3.17	3.85	4.79	6.20	6.47	7.44	6.36	6.11	7.57	5.40	12.02	11.81	20.11	20.04	63.98
39. Santa Isabel.....	9	22	1.24	0.75	1.31	1.59	4.95	4.40	3.67	3.80	5.56	6.41	4.65	2.16	4.15	7.85	11.87	16.62	40.67
40. Utuado.....	5	1,300	3.43	0.46	3.00	5.33	11.32	8.57	5.07	8.75	10.83	10.13	10.32	4.58	8.47	19.65	22.29	31.28	81.79
41. Utuado (San Salvador).....	9	1,500	3.83	2.22	4.80	5.24	9.60	5.64	5.49	7.71	11.11	8.53	10.64	5.29	11.34	19.64	15.84	30.28	80.10
42. Vieques (Island).....	11	45	3.51	2.38	2.61	3.34	4.06	5.68	5.05	5.75	7.12	7.07	5.26	2.98	8.87	10.01	16.48	19.45	53.81
43. Yabucoa.....	8	100	4.64	3.63	3.78	4.41	8.16	10.13	7.06	9.66	12.32	10.36	8.50	5.05	13.32	16.35	26.85	31.18	87.70
44. Yauco.....	11	200	2.13	0.90	2.61	3.19	4.48	5.28	3.87	5.84	5.70	6.82	5.33	1.76	4.88	10.28	14.99	17.85	48.00
Means.....			3.67	2.63	4.00	4.79	7.59	7.57	6.81	8.31	8.68	8.99	8.52	5.14	11.44	16.39	22.69	26.16	77.30
Maximum average.....			8.21	5.82	6.73	11.27	14.98	13.75	15.15	13.24	14.11	16.08	16.23	9.47	20.96	32.75	40.28	43.44	135.57
Minimum average.....			0.94	0.46	1.31	1.59	3.17	4.24	1.94	3.80	4.25	5.43	3.81	1.22	2.81	6.54	10.39	15.20	37.16

Maxima and minima are given in black figures.

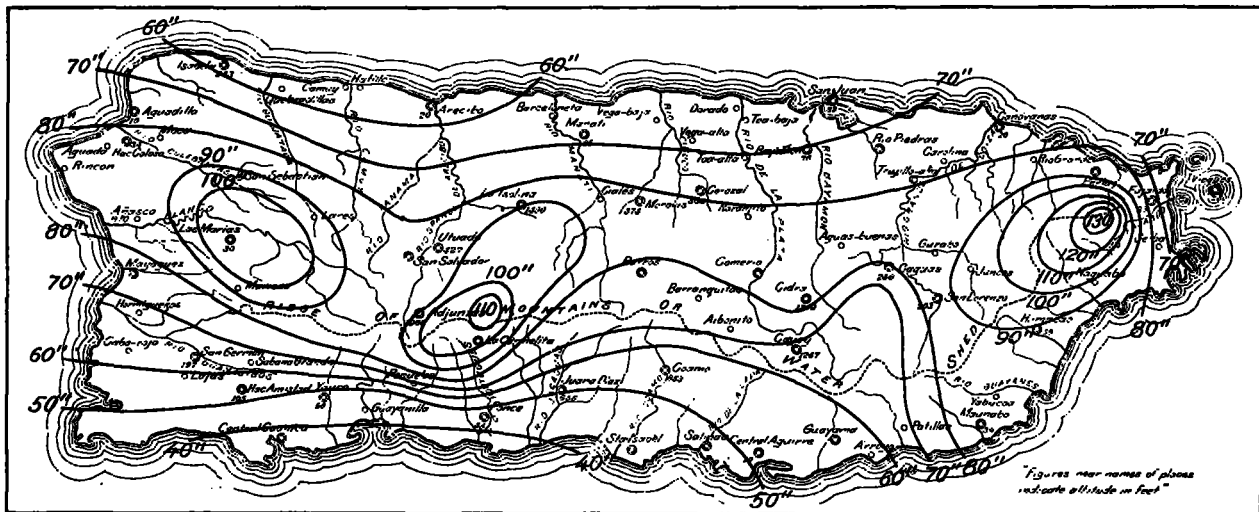


FIG. 1.—Porto Rico mean annual rainfall, 1899-1909.

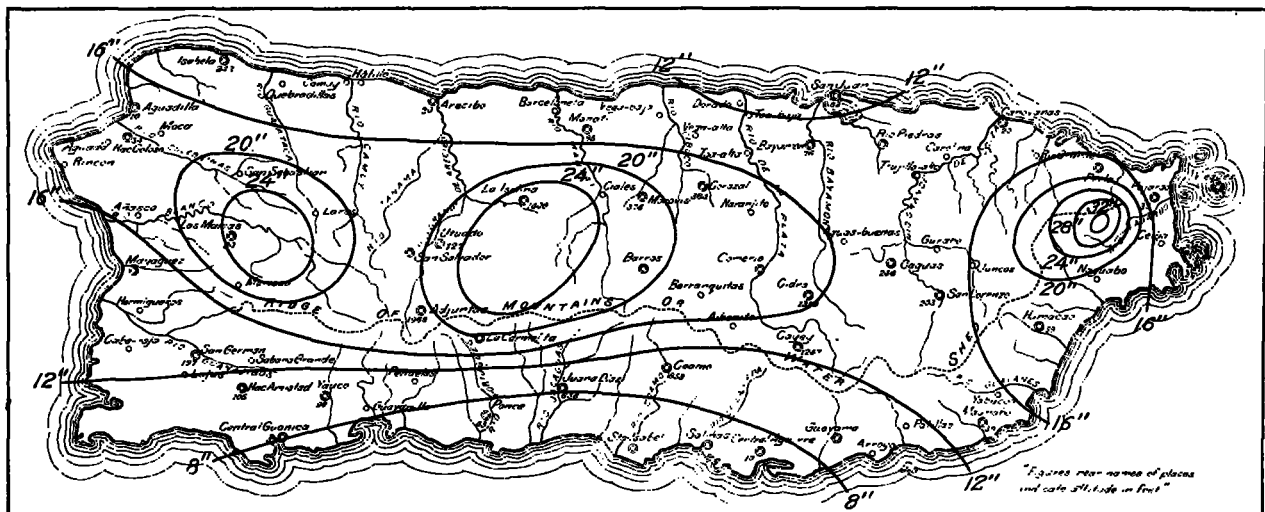


FIG. 2.—Porto Rico mean spring rainfall, 1899-1909 (March-May).

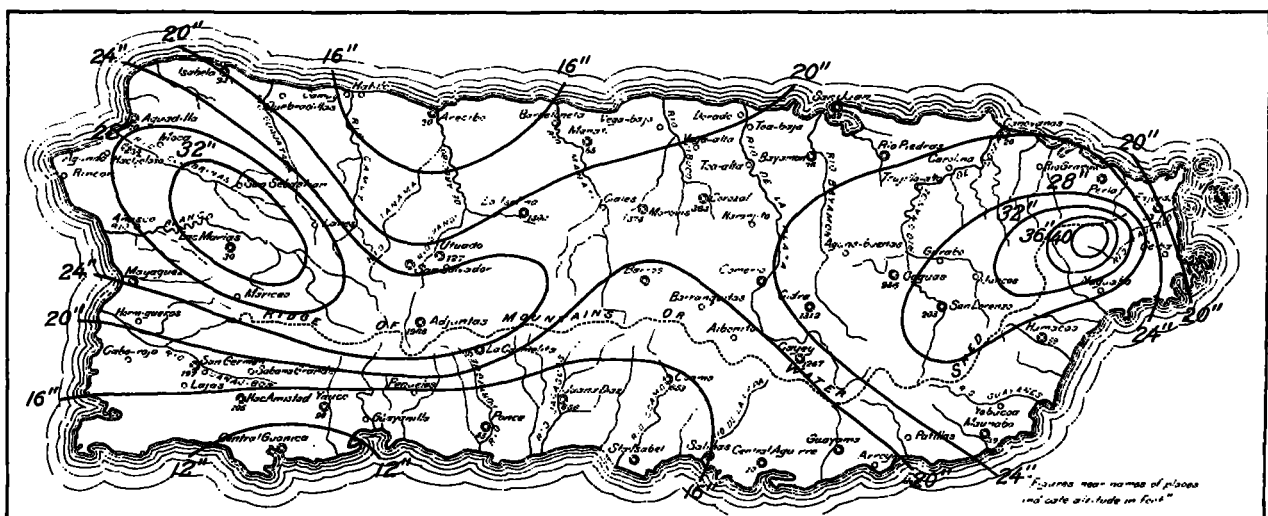


FIG. 3.—Porto Rico mean summer rainfall, 1899-1909 (June-August).

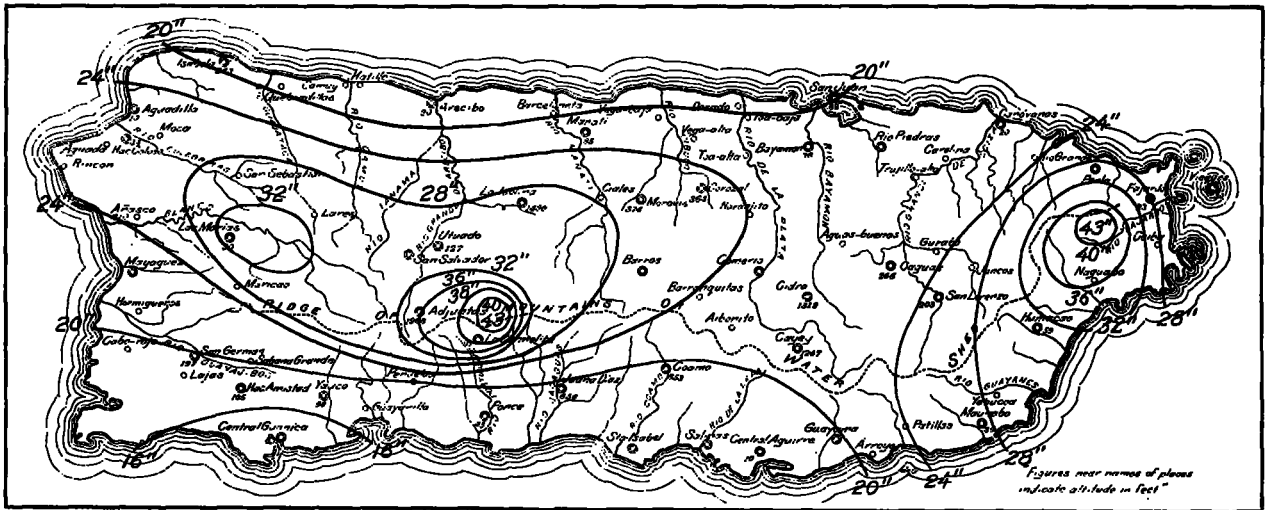


FIG. 4.—Porto Rico mean autumn rainfall, 1899–1909 (September–November).

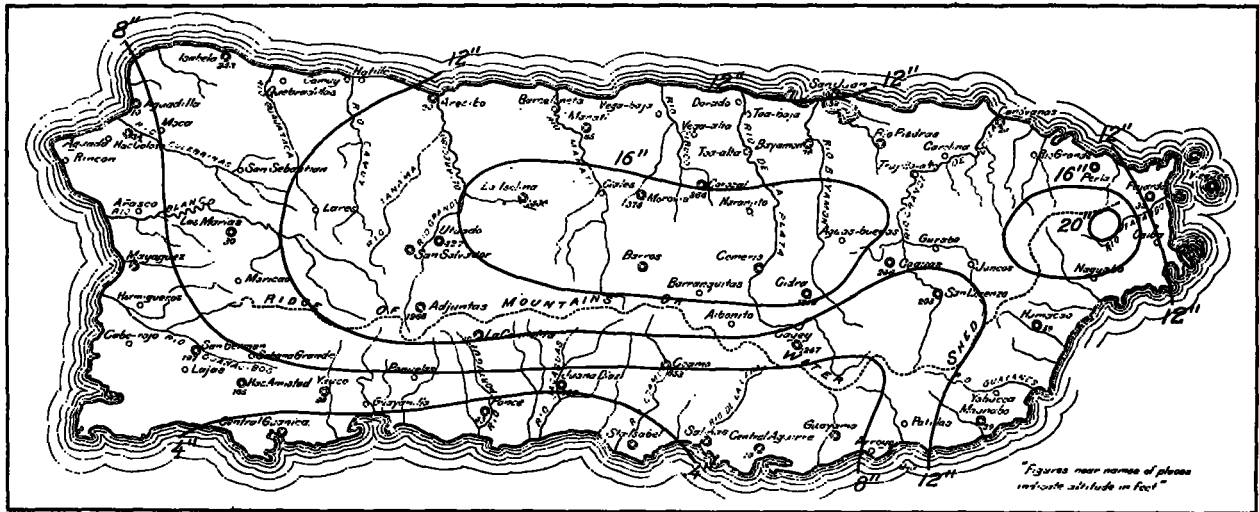


FIG. 5.—Porto Rico mean winter rainfall, 1899–1909 (December–February).

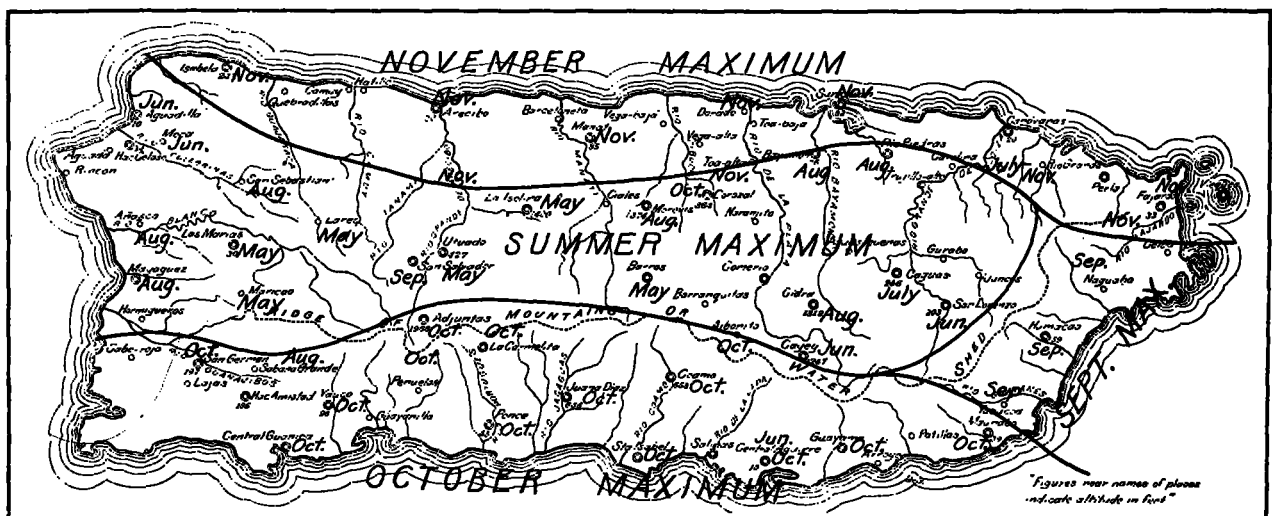


FIG. 6.—Map showing the month of maximum rainfall in Porto Rico, W. I.

Adjuntas, near the south-central part of the island, a region of coffee plantations; (3) a group of peaks in the west-central part, among which nestle the towns of Maricao, Las Marias, San Sebastian, and Lares, also a region of rich coffee plantations. In all of these centers the average annual rainfall exceeds 100 inches (see fig. 1).

The rainfall of the north side of the island differs from that of the south side not only in being greater in quantity but also in being more certain to fall in amounts sufficient for all the needs of plant growth at all seasons of the year. On the south side periods of 4 or 5 weeks with little or no rain are of frequent occurrence, while periods of 2 to 3 months with less than an inch of rainfall are not uncommon.

The scheme of irrigation now being provided for along the south coast will, in great measure, remedy the evils of an irregular and insufficient rainfall. In the mountains, but a few miles distant, there is an abundant water supply, available at all seasons of the year, which can be carried to the cane fields at comparatively small cost. At the present time it is costing the planters from \$25 to \$50 per acre per year to pump ground water for irrigating their cane fields.

There are no well-defined wet and dry seasons on the island. The winter rains (fig. 5) are comparatively light, with a minimum

in February at practically all stations having a record of more than 7 or 8 years. From February there is a steady increase in the rainfall through May. From May to November there is no uniformity in the variations. For the island, as a whole, the maximum is reached in October (see fig. 4), though the amounts from May to November are so nearly alike that a period of heavy rains may readily throw the maximum from one month into another, even with a record of 10 years or more. This was abundantly illustrated by the heavy rains of November, 1909, increasing the average value for the month in many localities to such an extent as to change the maximum from October to November. Charting the time of maximum rainfall (see fig. 6) we find a rough division of the island into three areas: South of the main divide the maximum occurs almost without exception in October; along the north coast it occurs in November; in the interior and on the west coast it falls in the summer months, from May to August. On the east coast it occurs in September.

In the seasonal distribution there is a progressive increase in the amount of rainfall, for the island as a whole, though the statement does not apply to individual stations (see figs. 2 to 5). The figures are: Winter, 11 inches; spring, 16 inches; summer, 23 inches; and autumn, 26 inches, making up the total of 77 inches for the average annual amount for the island.

WEATHER, FORECASTS, AND WARNINGS FOR THE MONTH.

By Prof. E. B. GARRITT, in charge of Forecast Division.

A barometric depression that advanced from the north Pacific coast from October 28 to November 2 was preceded by unusually mild temperature for the season and attended by general rains in middle and northern districts and by high winds on the Great Lakes and along the northern coasts. Following the passage of the storm-center there was a sharp fall in temperature. The appearance and passage of this storm was announced in a special forecast that was issued October 26. The following editorial from the Portland, Oreg., Oregonian of November 7 refers to this forecast and also to a hurricane that had occurred in southeastern waters:

A general storm warning was sent out about 10 days ago, and because Portland missed the storm center and failed to witness immediate results, it was assumed that the Weather Bureau had made a bad guess. But out at sea, just beyond the shore line and to the north and south, Old Boreas was holding high carnival, and for many days afterward nearly every craft that entered north Pacific ports brought tales of a fearful struggle with the elements, in which deck loads were lost, sails blown away, and houses smashed in by the seas. Here on the Pacific, with no near-by stations to the westward, and wireless not in sufficient use to enable steamers to report conditions, the service is not yet infallible on storms approaching from the sea. As an example of what can be done with reporting stations in all directions, the Weather Bureau service on the two West Indian hurricanes that struck the South Atlantic States in September and October was remarkable.

By giving warnings of these two hurricanes 5 days before they reached the Louisiana, Mississippi, and Florida coasts, it is estimated that there was a saving in property alone of no less than \$5,000,000. Several hundred small boats were wrecked in the harbor of Key West alone. Had the storm warnings not kept them in port, they would have been lost at sea with their crews, numbering many hundreds. At this season of the year the good work of the Bureau is shown to the best advantage in saving life and property along the seacoast. At other seasons of the year its accurate predictions of rain or frost enable farmers and planters to guard most effectively against loss.

Areas of low barometer of slight intensity that moved eastward along the northern border of the country from the 5th to 8th and 8th to 12th were attended by rains in the north-central States and caused an unusual prevalence of warm south-easterly winds generally over the country.

During the latter half of the first decade of the month a storm that apparently acquired intensity in that neighborhood and remained nearly stationary for a period of 4 or 5 days caused exceptionally heavy rains in Jamaica. From November 5 to 11, inclusive, the rainfall at Kingston was 30.45 inches. Six lives were lost, about 20 per cent of the banana crop

was destroyed, and much other damage caused by floods and high winds. The lowest barometer reading at Kingston during the storm was 29.70 inches on November 12. By the morning of November 11 the storm-center had advanced to a point near the west coast of Haiti, where great damage by flood was reported. Santo Domingo was also severely visited. Moving thence northeastward the center of disturbance passed near and north of the Azores during November 15 and 16, with minimum reported pressure at the Horta Observatory of 28.84 inches and maximum wind velocity of 56 miles an hour from the southwest. Vessels in the path of the storm, both in the Windward Passage and on the Atlantic, experienced gales of exceptional violence. For several days following November 16 pressure continued low between the Azores and the coast of Portugal, and severe weather was undoubtedly experienced in that region.

During the prevalence of this storm over the tropical and subtropical Atlantic, two typhoons visited the Philippine Islands. One swept over the island of Panay, Visayas group, on November 7 and caused considerable destruction of property and crops, and the other crossed the Philippines on the 15th and apparently recurved thence northward over the Japanese Islands and thence northeastward and eastward over the Pacific.

During the first half of the second decade of the month severe storms prevailed in northwestern and north-central Europe. At Cuxhaven the barometer fell to a reported reading of 28.80 inches on the 13th, and on the 14th a reading of 28.96 inches was reported at St. Petersburg. The storms encountered during this period on the North Sea were exceptionally severe.

On November 15 a special forecast announced a week or 10-day period of cooler weather for the eastern portion of the United States, with disturbances attended by rain in southern and snow in northern districts and followed by cool weather that would probably carry the frost line into the Gulf and South Atlantic States. Supplementing this forecast middle and north Pacific coast stations were advised on the 16th that a disturbance would reach that coast by Thursday the 16th.

From the 15th to 17th a disturbance of marked strength advanced from the southern Rocky Mountain region eastward and northeastward to the Atlantic coast, attended by snow